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Appropriateness of Routine Crossmatch in Elective Caesarean Section for Low Risk Postpartum Hemorrhage Pregnancies

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Abstract

Objective: The objective of this study is to evaluate appropriateness of the blood ordering practice and transfusion for elective caesarean section in low risk postpartum hemorrhage.

Materials and methods: A prospective descriptive study of routine cross-matching for elective caesarean section in low risk postpartum hemorrhage was conducted in Department of Obstetrics and Gynaecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand from 26 July 2016 to 31 March 2017. Data including patient demographics (maternal age, body mass index and gestational age) and operative findings (indications for caesarean section, levels of surgeon, amount of blood loss and blood transfusion, Hb change at 24 h after surgery, operation time and fetal weight) were collected. PPH rate and transfusion utilization indices (Crossmatch to Transfusion ratio (C/T ratio), Transfusion probability (%T) and Transfusion index (Ti)) were calculated.

Results: From 169 eligible participants, there were 2 cases excluded because of pre-operative undetected placenta adherent. There were five patients having PPH (3%). From 334 units of packed red cell (PRC) prepared for 167 patients, there were 6 units transfused to 5 patients. Only one patient received 2 units of PRC. Transfusion utilization indices (C/T ratio, %T, Ti) were 55.67, 2.99 and 0.03, respectively. Total cost for the cross matching process was 90,180 baht, but the actual transfusion cost was 2,700 baht.

Conclusions: Routine two units of cross matched PRC for elective caesarean section in low risk PPH was seemingly shown inappropriate and over ordering. It led to unnecessary expenses and time consuming.

Keywords: Caesarean section; Blood transfusion; Crossmatch; Blood preparation; Blood typing

Introduction

Postpartum hemorrhage (PPH) has been a major cause of morbidity and mortality in pregnant women in all parts of the world [1]. Risk factors of PPH are abnormal placentation (placenta previa, placenta adherent and abruptio placenta), uterine over distension (multifetal pregnancy, polyhydramnios and fetal macrosomia), grand multiparity, having history of PPH, prolong labour, pregnancy with uterine fibroid, receiving tocolytic drugs, delivery by caesarean section and severe anaemia (hemoglobin (Hb) less than 8 g/dl) [1-4]. Because caesarean section itself is one of the risk factors of PPH, it is possible that pregnancies undergoing caesarean section trend to have greater amount of intra-operative blood loss and have higher chance to receive blood transfusion even in the cases who have no other risk factors [5,6].

Decision concerning blood transfusion in the surgical cases depends on many factors: the type of operation, the extent and speed of blood loss and the presence of concomitant clinical conditions (age of the patient, heart disease and respiratory disorders) [7]. As an initial reference, the indications from the British Committee for Standards in Haematology Blood Transfusion Task Force have been proposed. These guidelines report the maximum acceptable request in standard operating conditions and in the presence of good transfusion practice. It is suggested that requested number of units of red cell concentrates should not exceed that of Maximum Surgical Blood Order Schedule (MSBOS). The proposed MSBOS for caesarean section in this recommendation is typing and screening [7]. However, MSBOS in each health care should be adapted to its local reality.

For all low risk PPH pregnancies undergoing elective caesarean section in Department of Obstetrics and Gynaecology, Faculty of Medicine Vajira Hospital, two units of PRC have been routinely pre-operative cross-matched. From the observation, our routine is not only different from the standard but also possibly unnecessary and over ordered. In addition, because of the limitation of blood components in blood bank, all blood components should be preserved for necessary cases that need blood transfusion. Therefore, appropriateness of blood preparation for each surgery is important for saving time, expenses, and workloads and also decreases in transmission of infection for the personals during blood preparation. According to all these reasons, this study is to evaluate the appropriateness of the blood ordering practice and transfusion for elective caesarean section in low risk PPH.

Methods and Materials

The prospective descriptive study was conducted in Department of Obstetrics and Gynecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand from 26 July 2016 to

31 March 2017. The research protocol received ethical approval from the Vajira Institutional Review Board and Ethical Committee in July 2016.

All pregnancies older than 18 years who underwent elective caesarean section at Department of Obstetrics and Gynaecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University were recruited. Inclusion criteria were term singleton pregnancy, age older than 18 years and planned elective caesarean section. Exclusion criteria were severe anemia (Hb<8 g/dl), Rh negative blood group and having other risk factors of PPH such as abnormal placentation (placenta previa, placenta adherent and abruptio placenta), uterine overdistension (multifetal pregnancy, polyhydramnios and foetal macrosomia), grand multiparity, having history of PPH, prolong labour, pregnancy with uterine fibroid and receiving tocolytic drugs. Sample size was calculated by using C/T ratio from 6-month pilot study at Vajira hospital. Pire value or C/T ratio was 0.098. With 0.95 of confidence (α=0.05), the calculated sample size by using the following formula was 135. When 20% dropout was added, 169 participants were required.

$$N=(Z2\alpha/2.\pi(1-\pi))/d2$$

All 169 enrolled participants were taken history, physical examination and ultrasound evaluation determining number of foetus, estimated foetal weight and amniotic fluid measurement. If there was no abnormality detected from the history, normal physical examination, no polyhydramnios and estimated foetal weight less than 4,500 g, the participants were included into the study. There was no one excluded from the study at this step. Each patient received the information about the study. After answering their questions until clear understanding, the written informed consents were obtained. Demographic data including maternal age, body mass index, and gestational age were collected. Pre-operative haemoglobin and haematocrit were performed.

Because all participants were healthy reproductive age without impairment of cardiac and lung functions, only volume and speed of blood loss, signs and symptoms of anaemia as well as levels of haemoglobin and haematocrit at 24 h post caesarean section were used for blood transfusion decision-making. Intra-operative blood loss was the sum of amount of blood in suction bag and estimated blood volume from all blood-stained swabs. Intra-operative blood transfusion depended on the allowable blood loss that was calculated by anaesthetists. The allowable blood loss (ABL) was calculated by using the following formula [8,9].

Allowable blood loss (ABL)=[EBV × (Hi-Hf)]/Hi

ABL=Allowable blood loss

EBV=Estimated Blood Volume=body weight (kg) × average blood volume (ml/kg)

Average blood volume=65 ml/kg in female adult

Hi=Initial haemoglobin

Hf=Final haemoglobin

Postoperative blood loss was calculated by weighing all sanitary pads used within 24 h. Total amount of blood loss was confirmed by haemoglobin and haematocrit change at 24 h post caesarean section. Postoperative blood transfusion depended on vital signs, the presence of signs and symptoms of anaemia as well as levels of haemoglobin and haematocrit at 24 h post caesarean section. Operative findings (indications for caesarean section, levels of surgeon, amount of blood loss and blood transfusion, Hb change at 24 h after surgery, operation time and fetal weight) were collected. PPH rate was calculated.

The data were analyzed by intention to treat using the SPSS software version 22. Categorical data were analyzed by using chi-square tests and continuous variables were analyzed by using Student's t tests. Mann-Whitney U tests were used for variables that were not normally distributed. Statistical significance was considered at $P<0.05$. Transfusion utilization indices including Crossmatch to Transfusion ratio (C/T ratio), Transfusion probability (%T) and Transfusion index (Ti) were calculated (Fig 1). C/T ratio less than 2% T more than 30% and Ti more than 0.5 meant appropriate blood preparation (Figure 1) [10-12].

$$Crossmatch-to-transfusion\ ratio\ (C/T\ ratio) = \frac{number\ of\ units\ crossmatch}{number\ of\ units\ transfused}$$

$$Transfusion\ probability\ (\%T) = \frac{number\ of\ patients\ transfused \times 100}{number\ of\ patients\ crossmatch}$$

$$Transfusion\ index\ (T_i) = \frac{number\ of\ units\ transfused}{number\ of\ patients\ crossmatch}$$

Figure 1: Formulas of transfusion utilization indices.

Result

This study was conducted between 26 July 2016 and 31 March 2017. There were 169 low risk PPH pregnancies that underwent elective caesarean section included. There were two cases of pre-operative undetected placenta adherent, but intra-operative known, excluded. From 167 pregnancies, 2 units of PRC for each patient were cross-matched. Pre-operative and 24 h postoperative Hb was measured. Indications for caesarean section, levels of surgeon, amount of blood

loss and blood transfusion, Hb change at 24 h after surgery, operation time and fetal weight were recorded. Demographic data and operative findings were shown in tables 1 and 2. There were five patients having PPH (3%) and the cause of PPH was uterine atony. Six units of PRC were transfused into 5 patients. Only one patient received 2 units of PRC.

Characteristic	Results
Age (years), mean ± SD (range)	29.33 ± 5.41 (18-43)
Weight (kg), mean ± SD (range)	69.50 ± 10.03 (43-107)
BMI (kg/m2), mean ± SD (range)	23.25 ± 3.35 (15.98-35.24)
Gestational age (weeks), mean ± SD (range)	38.30 ± 0.81 (37-40)

Table 1: Demographic data (N=167).

Operative findings	Results
Indications for caesarean section	
Previous C/S, n (%)	83 (49.7)
Fetal malpresentation, n (%)	22 (13.2)
CPD, n (%)	44 (26.3)
Other, n (%)	18 (10.8)
Level of surgeons	
Staff, n (%)	44 (26.3)
1st year resident, n (%)	2 (1.2)
2nd year resident, n (%)	75 (44.9)
3rd year resident, n (%)	46 (27.5)
PPH, n (%)	5 (3.0)
Transfusion (units)	
0, n (%)	162 (97.0)
1, n (%)	4 (2.4)
2, n (%)	1 (0.6)
Amount of blood loss (ml), mean ± SD (range)	481.20 ± 232.23 (100-2300)
Haemoglobin change (g/dl), mean ± SD (range)	0.92 ± 0.69 (0.3-5)
Operation time (min), mean ± SD (range)	75.90 ± 17.70 (45-185)
Fetal weight (g), mean ± SD (range)	3198.48 ± 342.13 (2260-4442)

Table 2: Operative findings (N=167).

Transfusion utilization indices were calculated for evaluation the appropriateness of routine cross-match in elective caesarean section for low risk PPH. Crossmatch to Transfusion ratio (C/T ratio), Transfusion probability (%T) and Transfusion index (Ti) were 55.7, 3% and 0.03, respectively as shown in (Table 3).

Owning to the regulation of The Comptroller General's Department of Thailand for the cost of typing and screening as well as cross-matching in all government hospitals, the cost of typing and screening in each patient was 240 baht and the cost of cross-matching was 150 baht added up for each unit of PRC. Therefore, the cost of 1 unit of cross-matched PRC was 390 baht and 540 baht for 2 units of cross-matched PRC as shown in table 4. To sum up, total cost of 334 units of cross-matched PRC in the study was 90,180 baht but actual cost of transfusion was only 2,700 baht. Surprisingly, total cost of routinely cross-matching was thirty three times greater than actual cost of transfusion.

Transfusion utilization indices	Calculated data	References for appropriate preparation
Crossmatch to Transfusion ratio (C/T ratio)	55.7	<2
Transfusion probability (%T)	3.00%	>30%
Transfusion index (Ti)	0.03	>0.5

Table 3: Transfusion utilization indices.

Blood preparation	Cost/case (Baht)	Total cost for 167 cases (Baht)
Typing and screening	240	40,080
Routine crossmatch		
PRC 1 unit	390	65,130
PRC 2 units	540	90,180

Table 4: Cost of each blood preparation.

Discussion

From the result of the study, incidence of PPH needed transfusion was 3%. Only one patient received 2 units of PRC. Transfusion utilization indices including Crossmatch to Transfusion ratio (C/T ratio), Transfusion probability (%T) and Transfusion index (Ti) were 55.7, 3% and 0.03, respectively. Comparing to the standard references, routine two units of cross-matched PRC for elective caesarean section in low risk PPH in our department was seemingly shown inappropriate and over ordering. These results were compatible with the results of the previous studies.

In the previous studies, there were various transfusion rates reported. Although improvement in surgical techniques could decrease blood loss and blood transfusion at the time of caesarean section, requirement of blood transfusion was still significant, especially in high risk cases [13]. From total 1056 deliveries, 327 pregnancies (31%) underwent caesarean section. While total of 654 units of blood were reserved, only 89 units (13.6%) were transfused. Majority of the patients did not need blood transfusion. 81% of those were transfused in emergency caesarean section. The most common indications for surgery among those transfused patients were placenta previa (9 patients with 21 units of blood) and cephalopelvic disproportion (8 patients with 13 units). There was no calculated C/T ratio for proper use of cross-matched reported [14]. Comparing to the present study, it reported higher blood transfusion rate. The participants that were all

caesarean section cases without classifying as low or high risk PPH pregnancies might be the reason. However, it still showed that most of the patients did not need blood transfusion.

The retrospective study in Thailand evaluating blood transfusion rate in all operations showed that transfusion rate for 478 caesarean section cases was 3.3%. Caesarean section seemed to use less blood than other operations whereas over cross-matching was ordered [15]. These results were compatible with ours. From 23,486 women underwent caesarean section in the prospective observational study in 19 universities, transfusion rate was 3.2% in primary caesarean section while the rate was 2.2% in repeated caesarean section [16]. Moreover, transfusion rate declined significantly from 22% in 1976 to 4 and 5% in 1996 and 2006, respectively because of improvement in surgical technique. Most of patients receiving blood transfusion were high risk PPH pregnancies [13]. Another study in 2,286 women in Thailand informed that C/T ratio in caesarean section was 5.7. The incidence of blood transfusion was only 2.6% of the 2,170 patients who were not cross-matched, thus 868,000 baht of cross-matching expenses was saved [17]. The results including low transfusion rate, high C/T ratio and cost saving from decrease in routine cross-match were compatible with those in our study.

Although the previous studies reported retrospective data about transfusion rate in all caesarean section cases without determining the risk of PPH or classifying the patients in specific groups such as elective or emergency cases and primary or repeated caesarean section [18-20], the results were still similar. Firstly, blood transfusion rate was quite low because of improvement of surgical technique. Secondly, blood transfusion was given mostly in high risk PPH.

This study was a prospective study in low risk PPH undergoing elective caesarean section. Therefore, all data were complete. Moreover, the amount of operative blood loss could be accurately recorded and confirmed by comparing pre- and postoperative Hb change. It was certain that the incidence of PPH and transfusion rate were reliable. Furthermore, this was the study in selected group so that the results were quite obvious and could confidently be applied in routinely clinical use.

From this study, we found low incidence of PPH and transfusion rate. Additionally, the total cost of routine cross-matching was thirty three times greater than the actual cost of transfusion. Moreover, according to the recommendation for transfusion of red cells from the British Committee for Standards in Haematology Blood Transfusion Task Force, the proposed MSBOS for caesarean section is typing and screening. With these reasons, the routine 2 units of cross-matched PRC in low risk PPH in our department might be changed, for examples typing and screening without cross-matching or only 1 unit of cross-matched PRC for each case, in order to reduce unnecessary tasks and expenses. However, MSBOS in each health care should be adapted to its local reality. For decreasing cost and unnecessary tasks without compromising the quality of care and safety as a result of the training risk that might affect the patients in our residency training, our departmental agreement preferred routine one unit of cross-matched PRC in low risk PPH. The limitation of the study was a small sample size. For further research, the appropriateness of blood preparation in high risk PPH should be studied.

Conclusion

Routine two units of cross-matched PRC for elective caesarean section in low risk PPH was seemingly shown inappropriate and over ordering. It led to unnecessary expenses and time consuming.

Acknowledgments

Disclosure

There were no conflicts of interest in this work.

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